

INDUCED MATING IN *FORMICA* ANTS (HYMENOPTERA:FORMICIDAE)¹

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While studying colony-founding in ants of the *Formica rufa* group, I encountered the problem of obtaining mated females so that I could isolate them in artificial nests to see if they can found their colonies without any workers. Although Gösswald and Schmidt (1960) were able to observe successful copulations of several European *Formica* species in their 30 x 25 x 22-cm glass container, I failed to collect any inseminated females of *Formica obscuripes* from either a 21 x 26 x 37-cm battery jar or a 30 x 44 x 120-cm wooden cage.

In the summer of 1968, after failing to induce mating of *Formica pergandei* in captivity, I collected male alates of this species from the tops of nests located at the University of North Dakota Oakville Praire Biological Station (12 miles W. of Grand Forks) and brought them into the laboratory. Each of these male alates was tied with a thread of hair between its petiole and gaster. They were brought back to the field the next morning during their normal flight time. A twig was used to receive a female alate which was climbing on grass. Special care was exercised to avoid disturbing her. After the female had climbed onto the twig, the tethered male was placed on the same twig (Fig. 1). The male was soon attracted to the female and mating took place within one minute (Fig. 2). After the male and female separated, the inseminated female was then collected by shaking the ant into a plastic bag, and finally transferred to a plastic vial for later use in the laboratory. This method has proved to be 100% successful for *F. pergandei*. However, when I tried the same technique with *F. obscuripes* in the summer of 1972, none of the males responded to the females walking on the twig.

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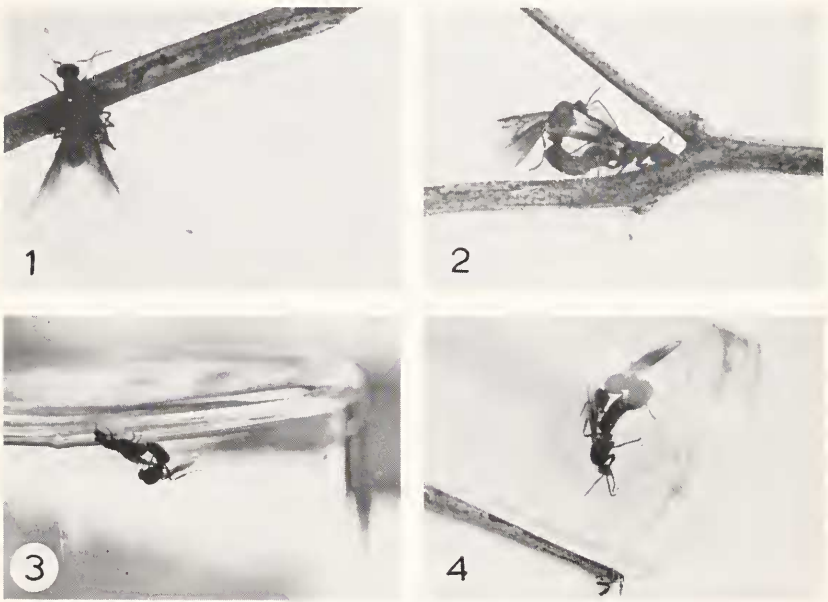
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Although intranidal mating has been reported in *Formica rufa*, ants of the genus *Formica* are generally ground-mating species (Kannowski, 1963). This type of mating may take place either prior to or after a flight. True flights have been observed in *F. obscuripes* in North Dakota (Kannowski, unpublished data), but no mating has yet been reported in North Dakota populations. According to Talbot (1959, 1972), alates of *obscuripes* in southern Michigan fly to a swarming ground where mating occurs. This seems to indicate that a flight is necessary before mating can take place. Indeed, in some *Formica* species the stimulus of flight is required to release or activate sex attraction (Kannowski and Johnson, 1969).

Based on this assumption alates of *obscuripes* were again collected from a nest top during their normal flight period and brought into the laboratory in the same morning. Each female alate was tied with a thread of hair between her petiole and gaster and then subjected to an air flow of 4 mph created by an electric fan for an hour. During this time she attempted to fly against the air current. At the end of the hour she was released into a plastic container to which a male alate was also introduced. No mating activity took place. Several days later I went back for additional alates, but it was so windy (12 mph) that the alates were not flying. Instead, they remained on the surface of the mounds moving among the workers. I picked up several females from one nest and several males from the other and kept them separated in two plastic vials. Later that morning when I put one of the males and one of the females in a one-gallon jar with several twigs in it and covered the jar with a lid, I witnessed the mating of *F. obscuripes* for the first time. This pair was then transferred to a plastic vial when mating was completed. I repeated this experiment with several other pairs in the same jar and mating took place in each instance within two minutes. Fourteen pairs were established and 10 matings were observed to take place. Smaller sized containers (4 and 8 oz. jars) were also used and successful matings were observed. The experiment was terminated at noon. After returning to the laboratory with these 10 mated females and several unmated alates of both sexes, I repeated the experiment. Three more matings were observed between 2-3 p.m., all in 8 oz. jar (Fig. 3). However, the other 6 pairs failed to respond to each other. The next morning the wind was at 4 mph

and alates were out on grasses on all nests. I collected alates from two different nests and put each pair in a plastic vial (2.5 cm in diameter and 11 cm in length). But only 3 pairs mated (Fig. 4). All the rest had no response even in the same gallon-jar. I tried it again the following morning, a calm day, and I was completely unsuccessful. Thereafter the weather condition was favorable for the flight, and I could no longer induce the mating.

There is now evidence that during mating the male is attracted to a pheromone released by the female (Kannowski and Johnson, 1969). The induced mating of *F. pergandei* reported here further supports this, since even when the male is tethered he is still



- Fig. 1. A tethered male of *Formica pergandei* landing on a twig.
 Fig. 2. Mating of *F. pergandei* on a twig with the male still tethered.
 Fig. 3. Mating of *Formica obscuripes* in an 8 oz. jar.
 Fig. 4. Mating of *F. obscuripes* in a plastic vial.

attracted to the female as long as she is not disturbed. In *Xenomyrmex floridanus* the female sex pheromone is produced in the poison gland (Hölldobler, 1971). The same gland in *Formica* might also be the source of sex pheromone and the chemical compound produced might serve either as an alarm substance or sex pheromone depending on its concentration. Females of *F. obscuripes* probably remain reproductively unattractive until they fly to the swarming ground. A similar case has already been reported in *Formica ulkei* (Kannowski and Johnson, 1969). However, if the *F. obscuripes* alates are prevented from flying as in the case of strong winds, mating can be induced when both sexes are placed in a closed container which probably simulates certain conditions of their swarming ground.

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ABSTRACT:—Induced mating in *Formica* ants (Hymenoptera:Formicidae).— Mating of *Formica pergandei* can be induced by tying the male with a thread of hair and placing it to an undisturbed female in the field during their flight period. *Formica obscuripes* will mate in a closed container when they are prevented from flight due to strong wind. (A. Chung-Fu Hung, Department of Biology, University of North Dakota, Grand Forks, ND 58201.

Descriptors: Ants; *Formica pergandei*; *Formica obscuripes*; induced mating.